



MICROCOPY RESOLUTION TEST CHART
IREAL - AND ARDS 1963 4

UNCLASSIFIED SECURITY CLASSIFICATION OF THIS PAGE	MASTER COPY	-	FOR REP	RODUCTION	PURPOSES
	REPORT DOCU	MENTATION	PAGE		
1a. REPORT SECURITY CLASSIFICATION		16. RESTRICTIVE	MARKINGS		
Unclassified		<u> </u>			
28. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION	/AVAILABILITY O	F REPORT	-
2b. DECLASSIFICATION / DOWNGRADING SCHED	DULE	Approve distrib	d for public ution unlim	release	;
4. PERFORMING ORGANIZATION REPORT NUM	BER(S)	S. MONITORING	ORGANIZATION R	EPORT NUMB	ER(S)
		A	20 246:	27.1-PH-	UIE
6a. NAME OF PERFORMING ORGANIZATION	66. OFFICE SYMBOL	7a. NAME OF M	ONITORING ORGA	NIZATION	
University of Rochester	(IT applicable)	11. 9	Army Rocesta	h Office	
6c. ADDRESS (City. State, and ZIP Code)		7b. ADDRESS ICA	v. State and 718	Code)	
The Institute of Optics		P. O. 1	Box 12211	/	
University of Rochester		Resear	h Triangle	Park, NC	27709-2211
Rochester, New York 14627	IAN DEFICE CAMBO	Q PROCLIPENSES	T INSTRUMENT IN	ENTIEL ATION	NUMBER
ORGANIZATION	(If applicable)	3. PROCUREMEN	- 1031707501110	ENTINATION	M CHARLE
U. S. Army Research Office		DA	1603-86-G	-0201	
8c. ADDRESS (City, State, and ZIP Code)		10 SOURCE OF	FUNDING NUMBER	I TACK	linean
P. O. Box 12211 Research Triangle Park, NC	27709-2211	ELEMENT NO.	NO.	NO.	ACCESSION
11. TITLE (Include Security Classification)		ــــــــــــــــــــــــــــــــــــــ		<u>i</u>	
Center for Opto-Electronic	Systems Research	- Instrument	ation Grant		
Center for Opto-Electronic	Systems Research	- Instrument	ation Grant		······································
Center for Opto-Electronic 12 PERSONAL AUTHOR(S) Nicholas Ceorge	Systems Research	- Instrument	tation Grant	·	
Center for Opto-Electronic 12 PERSONAL AUTHOR(S) Nicholas George 13a. TYPE OF REPORT 13b. TIME	Systems Research COVERED	- Instrument	eation Grant	Ooy) 15. PA	GE COUNT
13a. TYPE OF REPORT 13b. TIME FINal FROM 1	Systems Research COVERED 0/1/86 TO 11/14/8	- Instrument	cation Grant	Day) 15. PA	GE COUNT
16 SUBBLEMENTARY MOTATION	II/I/86 IO II/IA/8	2/1/88			11
16. SUPPLEMENTARY NOTATION The view	, opinions and/or	r findings co	ontained in	this repo	ort are thos
16 SUBBLEMENTARY MOTATION	, opinions and/or	r findings co	ontained in al Departmen	this repo	ort are thos Army positi
of the author(s) and should noticy or decision unless s	o designated by	r findings co	ontained in al Departmen	this repo	ort are thos Army positi
of the author(s) and should notice or decision unless s	o designated by	r findings co	ontained in al Departmen	this repo	ort are thos Army positi
of the author(s) and should noticy or decision unless street (COSATI CODES FIELD GROUP SUB-GROUP	opinions and/or ot be construed to designated by	r findings constant deciments an official of the continue on revenue on N/A	ontained in al Departmen	this repo	ort are thos Army positi
of the author(s) and should notice or decision unless s	opinions and/or ot be construed to designated by	r findings constant deciments an official of the continue on revenue on N/A	ontained in al Departmen	this repo	ort are thos Army positi
of the author(s) and should noticy or decision. Impless s To COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Comminue on reverse if necessariants)	opinions and/or ot be construed to designated by 18. SUBJECT TERMS (r findings coas an official continue on reven	ontained in al Departmen in arrive and arrive arrive and arrive and arrive arri	this repo t of the didentify by	ort are thos Army positi block number)
of the author(s) and should noticy or decision. Impless s To COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Commune on reverse if necessariants) This final report contains	opinions and/or ot be construed to designated by 18. SUBJECT TERMS (r findings constant documents an official (Continue on reven) N/A number)	ontained in all Departments are if necessary and the purchased	this report of the distance of	ort are thos Army positi block number)
of the author(s) and should noticy or decision. Indies s 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Commune on reverse if necessary This final report contains Center for Opto-Electronic contains Center for Opto-Electronic contains 16. Supplementary NOTATION The view of the vie	ry and identify by block ns a listing of capi onic Systems Rese	r findings constant documents N/A number) tal equipments arch during ``	ontained in all Departments of mecessary and the if mecessary and the if purchased fear 1 of the control of the	this report of the distance of	ort are thos Army positi block number) O-URI This
This final report contain The view of the author(s) and should n noticy or decision indess s To cosati codes FIELD GROUP SUB-GROUP This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t	ry and identify by block ns a listing of capitantic Systems Reserved to support the reference one following are	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
16. SUPPLEMENTARY NOTATION The view of the author(s) and should n noticy or decision invess s 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessar This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t understanding, (b) o	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS (18. SUBJECT TERMS	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
This final report contain The view of the author(s) and should n noticy or decision indess s To cosati codes FIELD GROUP SUB-GROUP This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS (18. SUBJECT TERMS	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
16. SUPPLEMENTARY NOTATION The view of the author(s) and should n noticy or decision invess s 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessar This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t understanding, (b) o	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS (18. SUBJECT TERMS	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
16. SUPPLEMENTARY NOTATION The view of the author(s) and should n noticy or decision invess s 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessar This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t understanding, (b) o	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS (18. SUBJECT TERMS	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
16. SUPPLEMENTARY NOTATION The view of the author(s) and should n noticy or decision invess s 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessar This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t understanding, (b) o	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS (18. SUBJECT TERMS	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
16. SUPPLEMENTARY NOTATION The view of the author(s) and should n noticy or decision invess s 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessar This final report contain Center for Opto-Electro equipment is being use doctoral scholars in t understanding, (b) o	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS (18. SUBJECT TERMS	r findings comes as an official continue on revenue on	t purchased fraculty investigation	this report of the distance of the AR e Center. Itigators and in the arms of t	ort are thos Army positi block number) O-URI This and 20 mage
The view of the author(s) and should noticy of decision unless s. 17. COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessary doctoral scholars in tunderstanding, (b) o optoelectronic systems.	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS on a listing of capitonic Systems Reserved to support the reptical system designated by the support of the following are optical system designated by the system designated by the support of the support of the system designated by the support of the system designated by the support of the system designated by the support of the support of the system designated by the support of the su	r findings comes an official continue on revenue (Continue on revenue) N/A number) tal equipmen arch during research of 12 eas: (a) sign, and (c)	t purchased fraculty investal processi sources at	this report of the distribution of the dindividution of the distribution of the distribution of the distri	ort are thos Army positi block number) O-URI This and 20 mage
The view of the author(s) and should not decision unless s. To COSATI CODES FIELD GROUP SUB-GROUP 19 ABSTRACT (Continue on reverse if necessary Center for Opto-Electric equipment is being use doctoral scholars in tunderstanding, (b) optoelectronic systems.	n, opinions and/or ot be construed to designated by 18. SUBJECT TERMS on a listing of capitonic Systems Reserved to support the reptical system designated by the support of the following are optical system designated by the system designated by the support of the support of the system designated by the support of the system designated by the support of the system designated by the support of the support of the system designated by the support of the su	r findings comes an official continue on reversion (Continue on reversion N/A number) tal equipment arch during research of 12 as: (a) sign, and (c)	t purchased fear 1 of the faculty investal processi sources as	this report of the distribution of the dindividution of the distribution of the distribution of the distri	ort are thos Army positi block number) O-URI This and 20 mage rs for

DD FORM 1473, 84 MAR

All other editions are obsolete.

DE VIEW DE CONTRACTOR CONTRACTOR DE CONTRACT

SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED

Center for

OPTO-ELECTRONIC SYSTEMS RESEARCH INSTRUMENTATION GRANT FINAL REPORT -- YEAR I

1 October 1986 - 14 November 1987

COMES

Hor al

DTIC COPY

SCOPE OF REPORT

The attached listing is an accurate itemization of equipment actually purchased under the subject grant. Prices are listed from billings but they should be considered as approximate only, and those showing an asterisk (*) do not represent final billings since these were not available at the time (January 1988) of writing of this report. The formal grant report is being prepared by the Office of Research and Project Administration of the University of Rochester and it will contain official dollar values.

As stated in the initial proposal to the Army (Section III.A.1),

"Single investigator support is extremely important to the quality of the research and the education it provides to graduate students. Very often, however, interrelated research projects in a given area represented by a group of faculty would benefit greatly by having access to major items of equipment whose cost is prohibitive to the single investigator. Also, such equipment always needs to be managed in a way which guarantees its availability to many users in an orderly manner and its timely maintenance to insure continued usefulness. One of the most important activities of the proposed Center will be to help solve this problem."

Three separate faculty were appointed to plan the major facilities for the Center. Each set up an ad-hoc committee for planning purposes, and the University of Rochester made additional space available to house these items for centralized use. The three facilities are I. Digital Image Processing - G. Michael Morris; II. Optical Materials Processing and Characterization - Dennis G. Hall; and III. Infrared O-E Systems Laboratory - Nicholas George.

Of the initial \$1,000,000 approximately \$240,000 was committed to these Center facilities with the remaining funds budgeted to individual faculty investigators. Priorities were assigned to the development of the central facilities based upon the actual research flow, and an orderly system of acquisition has been planned for the first five years of the program.

The following listing includes all items of equipment authorized and purchased under the subject grant.

ítem	Description (Generic, Vendor, Buyer)	Amount Paid
1	Picosecond Nd: YAG Laser Quantel International Model CV 401 Control Unit Model PV 420 500 W Charging Unit Model PV 430 1500 W Charging Unit Model CB 430 S Simmer Capacitor Bank Model CB 430 Capacitor Bank Model CG 503 Cooling Group 3KW Model SF 55-09 Laser Head & Lamps & Rods Model D Frequency Double for p sec Model 27 Unit Electronic Cabinet Model 532 Dichroics on MM-25 TOTAL Newport Research Corporation	44, 071.
	Model RS-48-12 Honey Comb Table Model NN4-22 Non-isolating Support System TOTAL	5,975.
	TOTAL	50,046.
2	General Purpose Dye Laser Spectra Physics Model 3758-91 CW Dye Laser Model 372B Accumulator for above Model 373 Dye Laser Intensity Stabilizer Model 377 Alignment Platform TOTAL	12,541.
3	Infrared Camera and Monitor Hamamatsu Corp. Model ITC-510/N2606-02 Ikegami video camera with infrared Vidicon installed TOTAL	2,261.
4	Closed-Cycle Helium Cryostat APD Cryogenics Model CSW-202-81C Displex Closed Cycle Refrigeration System Accessories TOTAL	18,426.
5	Spectrum Analyzer Hewlett Packard Model 8570A 10MHz-21GHz Spectrum Analyzer TOTAL	20,000.

Item	Description (Generic, Vendor, Buyer)	Amount Paid
6	Fourier Transform Infrared Spectrometer Nicolet Instrument Corporation Model 912A0082 20SXC Optical Bench Model 840-201500 Germanium/Beamsplitter Model 840-109200MCT-B Detector Model 912A0099 660 Data System Model 843-103700 SMD Interface Model 843-028000 86 M Byte SMD Drive Model 869-024900 HP7470A Plotter Model 912A0047 20SXC GC Interface Installation TOTAL	75,394.
7	Photon-Correlation System Coulter Electronics, Inc. Model 1096 Digital Correlator Accessories TOTAL Hamamatsu Corp. Model R464 Photomultiplier Tube, 2" TOTAL Products for Research, Inc. Tube Socket Assembly for Hamamatsu R464 PMT TOTAL TOTAL	20,007. 978. 605. 21,590 .
8	CW Mode-locked Nd:YAG Laser Coherent, Inc. Model CR-699-21 Actively Stabilized, Single Frequency Scanning Ring Dye Laser System with Accessories TOTAL	* 58,395 .
9	IBM Computer Computer Store Model IBM AT-399 Acessories TOTAL	*6,775.
10	OMA Detector EG&G Princeton Applied Research Model M1421BR-G Grated Intesnsified Diode Array Detector TOTAL	29,518.

^{*}Amount approximate; invoice outstanding.

Item	Description (Generic, Vendor, Buyer)	Amount Paid
11	Computer Equipment and Software Cameron Computers Model 9133H 20 Mbyte Winchester Hard Disk TOTAL Infoteck Systems Model MF300 Motorola 68881 based F/P	2,030.
	Coprocessor Driver BIN and CSUB Real Arithmetic Module Model AM200 1.0 Megabyte Memory Board TOTAL IEM, Inc.	2,956.
	Model 1927006 Basic 4.0 Compiler, Binary Form Model 3700704 Standard Software Support TOTAL	995.
	Hewlett Packard Model 98613B RAM-based BASIC 4.0 Language TOTAL	260.
	TOTAL	6,241.
12	Computer Leon's SuperMAC 16" Color Trinitron Monitor Tilt/Swivel Stand Spectrum 1000/8 Video Board	40.546
	TOTAL UR Computer Sales MacIntosh II w/40Mb Drive and Accessories TOTAL	*3,546. 3,859.
[TOTAL	*7,405 .
13	High Power Argon-Ion Laser Coherent, Inc., Laser Products Division Model 100-20UV Innova 20 watt argon laser Model 434-UV Ultraviolet wavelength selector Model 924 Single-frequency Etalon Etalon for ultraviolet lines Six-month warranty	
	TOTAL	53,358.

^{*}Amount approximate; invoice outstanding.

Item	Description (Generic, Vendor, Buyer)	Amount Paid
14	MAC + Computer Store MAC Laser Writer Accessories TOTAL	6,184.
	Leon's Computers MAC Table Model 4175 Stand w/shelf insert Model 5820 Chair TOTAL	569 .
	TOTAL	6,753.
15	Optical Components Zygo Corporation Transmission sphere, 4", F/no: 3.3 Reference sphere: 37mm, 4%, F/no 0.68 TOTAL Continental Optics Model CT-100 Collimation Tester	5,252.
	TOTAL	904. 6,156.
16	Storage Oscilloscope Educational Institutional Corp. Model 2235 Tektronix 100MHz trace Oscilloscope Model K212 Oscilloscope Cart TOTAL	1,726.
17	Etalon Assembly Coherent Upgrade CR-699-01 Broadband Ringe Dye Laser TOTAL	7,028.
18	RF Spectrum Analyzer Hewlett Packard Model 8590A Spectrum Analyzer 10KHZ-1.5 GHZ Model 8590A-021 P-IB Interface Model 10833A HP-IB 6' Cable Model 82990A P-IB Interface Card TOTAL	10,510.

Item	Description (Generic, Vendor, Buyer)	Amount Paid
19	Lock-In Amplifier UR Computer Sales Model 339 IBM PC AT Computer System Accessories, assembly, testing TOTAL	3,919.
	Stanford Research Systems, Inc. Model SR-530 Two Phase Lock-In Amplifier Model SR-575 Source-code for Control Program Model SR-550 Remote Gain-controlled Voltage Pre-amp Model SR-540 Remote Frequency-Controlled Chopper TOTAL	5,585.
	Brighton Computers Model AST Advantage Premium Expansion Board Model AST Advantage Premium Piggyback Board Quadram Pro-sync + Extended Graphics Adaptor Model 80287-8 IBM Math Coprocessor TECHMAR Labmaster Board	
	TOTAL	4,983 .
<u> </u>	TOTAL	14,487.
20	Computer Definicon Systems, Inc. Model 851-750-1 32 Bit 68020 Coprocessor Fortran Compiler TOTAL	1,947.
	Entre' Computers IBM XT w/dual 360K floppy, 20 Mb hard disk TOTAL	1,470.
	Vue Com Model WV-CD20 Panasonce 23" B&W CCD Camera Model TR930 9" B&W Camera Monitor TOTAL	1,095.
	Spectra Services Model PC-VIsion plus Frame Grabber TOTAL	1,966.
j	TOTAL	6,478.

Item	Description (Generic, Vendor, Buyer)	Amount Paid
21	Precision Positioning Electronics Spectra Services Model EG-233 Digital Linear Gauge Model ST-022 Gauge Stand Model RQ-281 Printer for above Accessories	
	TOTAL Klinger Scientific Corporation	1,080.
	Model 354-479 UT-100-150-PP Linear Stage Model 385-900 Position Encoder TOTAL	3,936.
	TOTAL	5,016.
22	High Performance Liquid Chromatograph VWR Scientific, Inc. Model EM-Hitachi HPLC System TOTAL	13.500
		13,500.
23	Camera w/Photo Diode Trigger Hamamatsu Photonic Systems Corp. Model C2830 Streak Camera System Model M2547 10psec Resolution Plug-in Model A1976-01 1:1 Input Optics Model M2493-10 Photodiode Array TOTAL	54,309.
24	Plane-Parallel Fabry-Perot Burleigh Instruments Model RC-110 Plane-Parallel Fabry-Perot Model RC-670 Mirror Set Model RC-43 PZT Driver	
	TOTAL Tektronix, Inc.	10,103.
	Model RTD 710 Waveform Digitizer TOTAL (\$19,950 total, partially supported by grant)	*11,750.
	TOTAL	*21,853.
25	Computer Accessories UR Computer Sales Model M2640 Apple Tape Back-up 40SC TOTAL	1,090.

^{*}Amount approximate; invoice outstanding.

item	Description (Generic, Vendor, Buyer)	Amount Paid
26	Infrared HeNe Laser Physitec Model 04-0510 HeNe Laser, Multiline Model 04-0545 Single Wavelength Mirror TOTAL	6,326.
27	Computerized Surface Profiling System Tencor Instruments Model 10-02000 Alpha-Step 200 Model SHS0002A Thin Film Calibration Set Accessories TOTAL	33,837.
28	Adapter for Stereozoom TBR Associates Model 42-12-45-02 Bausch & Lomb 1" CCTV Adapter for Stereozoom 7 TOTAL	113.
29	Silicon Wafers Spire Corporation SIMOX WAFER Annealing Epitaxial Silicon Deposition TOTAL	5,423.
30	Wafer Cleaner/Dryer System Headway Research, Inc. Model MC75 Wafer Cleaner/Dryer System TOTAL	18,168.
31	Optical Equipment Newport Research Model F-915 Precision Stage Model LS-24 Breadboard Assored Equipment TOTAL	4,139.
32	Controller Omega Engineering, Inc. Model CN2002-MV1-0-DC2 Controller TOTAL	753.
33	Computer IBM Model 339 PC/AT Accessories TOTAL	*3,933.

^{*}Amount approximate; invoice outstanding.

ltem	Description (Generic, Vendor, Buyer)	Amount Paid
34	Computer Monitor Leon's Model KV-2511CR Sony Trinitron Computer Monitor/TV TOTAL	1,121.
35	Video Monitor Miller Assoc. Model PM-970 Ikegami 9" B/W Video Monitor TOTAL	365.
36	Thermoplast Recorder Newport Corporation Model HC-300 Thermoplast Recorder Model HC-301 Thermoplastic Plate Model HC-302 Detector TOTAL	15,104.
37	Burners Wale Apparatus Model L9173S Litton 4-fire Burner Assored Hardware TOTAL	377.
38	High Voltage Supply Northeast Scientific Corp. Model RQE-1601-2121 High Voltage Supply Model RQE-5001-6321 High Voltage Supply Model RQE-5002-2121 High Voltage Supply TOTAL	*3,035.
39	Closed Cycle Refrigerator RMC-Cryosystems Model LTS-4.2-025-VTO Closed Cycle Refrigerator Turbomolecular Pumping System TOTAL	*37,650.
40	Monochromator McPherson Model 8191-1301-O Monochromator Model 789A Scan Controller Model 650 Basic End-on Housing Accessories TOTAL	*9,180.

^{*}Amount approximate; invoice outstanding.

ltem	Description (Generic, Vendor, Buyer)	Amount Paid
41	Stage Aero Tech Model AS302M TOTAL	1,244.
42	Lockin Amplifer EG&G Princeton Applied Research Model 5208 TOTAL	4,510.
43	Computer UR Computer Store Model M5400 Macintosh II Accessories TOTAL	5,516.
44	Laser Liconix Model 4210NB 10mW He-Cd Laser TOTAL	*7,500 .
45	Filter Newport Research Model DT2805/3716 D/A Board TOTAL	3,000.
46	Board Data Translation Model 900 Spatial Filter TOTAL	2,072.
47	Spatial Light Modulator Hamamatsu Corporation Model X1699 Microchannel Spatial Light Modulator TOTAL	24,500.
48	Controller Technology Advancement Group Model M3 MSLM Controller TOTAL	*8,900.
49	Preamplifier Surface Science Laboratories Model 24012A Preamplifier for 2401 Position Computer and ITT F4146M Image Converter TOTAL	3,755.

^{*}Amount approximate; invoice outstanding.

ltem	Description (Generic, Vendor, Buyer)	Amount Paid
50	Tape Back-up System Brighton Computers Model TD-4340 Micro Mountain File Safe Tape Back-up System TOTAL	555.
		222.
51	Computer Accessories Hard and Soft, Inc. MemChips TOTAL	2,012.
52	Argon Laser System Spectra Physics, Inc. Model 2020-055 Argon Laser System Model 375B-81CW Dye Laser Accessories TOTAL	*40,050 .
53	Rapid Thermal Processor/CVD System Nanosil, Inc. Model RTCVD-6000 Rapid Thermal Processor Accessories TOTAL	*91,229 .
54	Ion Beam Etching System Veeco Instruments Model 301M Ion Beam Etching System with electrostatic plate and maintenance kits Installation charges estimated TOTAL	*118,455. *8,872. *127,327.
55	MASSCOMP Upgrade MASSCOMP Model PEP-567-30 Add on CPU for 5700 System BP2-57-15 Add on Backplane Model SFRA-2 Super Lightning Floating Point Installation Charges TOTAL	*27,450.

^{*}Amount approximate; invoice outstanding.

Sub-Total (for this page) \$288,623

Unaudited Estimate of Total Expenditures for Year I \$1,000,000

1) At L FILMED - 88 111